

NATURAL RESOURCES CONSERVATION SERVICE CONSERVATION PRACTICE STANDARD

IRRIGATION SYSTEM, SPRINKLER

(No. and Acre)

CODE 442

DEFINITION

A planned irrigation system in which all necessary facilities are installed for efficiently applying water by means of perforated pipes or nozzles operated under pressure.

PURPOSE

To efficiently and uniformly apply irrigation water to maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion, or reduced water quality.

CONDITIONS WHERE PRACTICE APPLIES

Sprinkler irrigation system where water is distributed by means of sprinklers or spray nozzles. It applies to all components of the on-farm system except for special structures such as permanently installed mains and laterals in accordance with Conservation Practice Standards 430, Irrigation Pipeline, and 533, Pumping Plant.

Sprinkler irrigation plans shall be based on an evaluation of the site and the expected operating conditions. The soils and topography shall be suitable for irrigation for the proposed crops.

Enough good-quality water must be available for practical irrigation of the crops to be grown.

The sprinkler method of water application is suited to most crops, to most irrigable lands, and to most climatic conditions where irrigated agriculture is feasible.

CRITERIA

General Criteria Applicable to All Purposes

This practice shall conform to all Federal, State and Local laws and regulations. Laws and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

Depth of application. The maximum net depth of application shall be based on the available moisture capacity of the soil in the root zone of the crop irrigated or a lesser amount consistent with the land user's operation plan. The gross depth shall be determined by using field application efficiencies consistent with the conservation of water resources.

Capacity. In regularly irrigated areas, sprinkler irrigation systems shall have either (1) a design capacity adequate to meet the moisture demands of all crops to be irrigated in the design area or (2) enough capacity to meet the requirements of several selected irrigations during critical crop growth periods when less than full irrigation is planned. In computing capacity requirements, allowance must be made for reasonable water losses during application periods.

Systems for special-purpose irrigation shall have the capacity to apply a stated amount of water to the design area in a specified net operating period.

Design application rate. The design rate of application shall be within a range established

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by the minimum practical application rate under local climatic conditions and the maximum rate consistent with the intake rate of the soil and the conservation practices used on the land. If two or more sets of conditions are in the design area, the lowest maximum application rate for areas of significant size shall apply.

Distribution patterns and spacing. A combination of sprinkler spacing, nozzle sizes, and operating pressure that most nearly provides the design application rate and distribution shall be selected. The velocity of prevailing winds and other conditions must be considered.

If available from the manufacturers, uniformity coefficient data shall be used in selecting sprinkler spacing, nozzle sizes, and operating pressure. The uniformity coefficient shall be not less than as shown below:

- 70% for orchards
- 75% for deep-rooted (4 ft or more) field and forage crops
- 85% for high-value or shallow-rooted crops and for any crop where fertilizer or pesticides are applied through the system.

In the absence of such data, sprinkler performance tables provided by the manufacturers shall be used in selecting nozzle sizes, operating pressure, and wetted diameter for the required sprinkler discharge.

The maximum spacing shall comply with the following criteria:

1. For low-, intermediate-, and moderate-pressure sprinklers, the spacing along lateral lines (S_l) shall not exceed 50 percent of the wetted diameter (as given in the manufacturer's performance tables) when the sprinkler is operating under optimum pressure. The spacing of laterals along the main line (S_m) shall not exceed 65 percent of this wetted diameter. If winds that can affect the distribution pattern are likely, spacing (S_m) shall be reduced to 60 percent for average velocities of 5 miles per hour (mph), to 50 percent for average velocities of 10 mph, and to 30 percent for average velocities greater than 10 mph.

2. For high-pressure sprinklers and for the giant hydraulic type, the maximum distance (diagonal) between two sprinklers on adjacent lateral lines shall not exceed two-thirds of the wetted diameter under favorable operating conditions. If winds that can affect the distribution pattern are likely, the diagonal spacing shall be reduced to 50 percent of the wetted diameter for average velocities of 5 mph and to 30 percent for average velocities greater than 10 mph.
3. For perforated pipelines, the spacing recommendations of the manufacturer for the design application rate, number and size of perforations, and operating pressure shall be followed.
4. Continuous move systems shall apply the desired amount at the design rate with uniform distribution.

Lateral lines. Lateral lines shall be so designed that the total pressure variation at the sprinkler heads, resulting from friction head and static head, does not exceed 20 percent of the design operating pressure of the sprinklers.

Except for under tree operation, riser pipes used in lateral lines shall be long enough to prevent interference with the distribution pattern when the tallest crop is irrigated. Riser lengths shall not be less than shown below:

Sprinkler discharge (gal/min)	Riser length (in)
Less than 10	6
10-25	9
25-50	12
50-120	18
More than 120	36

Main lines. The design of main lines, submains, and supply lines shall insure that the quantities of water required are conveyed to all lateral lines at the maximum required pressure.

If the pressure required for sprinkler system operation is provided by pumping, main line pipe sizes shall insure that there is an economical balance between the capitalized cost of the pipe and annual pumping costs.

Pump and power unit. The pump capacity and the power unit shall be adequate to operate the sprinkler system efficiently when maximum capacity is being pumped against maximum total dynamic head.

CONSIDERATIONS

Runoff lowers overall system efficiencies due to non-uniformity of application. Ponding or over-application in any area of the field can lead to deep percolation, potentially contaminating ground water quality. Special nozzles on the system should be considered to reduce excessive runoff to acceptable averages.

Wheel tracks that develop from continuous move systems will require annual maintenance. Fields with annual crops can be filled each year before planting. Tracks developed in alfalfa or grass need special maintenance to avoid runoff water traveling in the tracks causing erosion.

Water Quantity

- Effects on the water budget, especially the volume and rate of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.
- Potential for changes in plant growth and transpiration because of changes in the volume of soil water.
- Effects on downstream flows or aquifers that would affect other water uses or users.
- The effect on the water table of the field in providing suitable rooting depth for anticipated land uses.
- Potential ability to manage irrigation water through control of water in the root zone.

Water Quality

- Effects on erosion and the movement of sediment, and soluble and sediment-attached substances carried by runoff.
- Effects of nutrients and pesticides on surface and ground water quality.

- Potential effects on the movement of dissolved substances below the root zone or to ground water.
- Effects of soil water levels on such nutrient processes as nitrification and denitrification.
- Effects of soil water levels in controlling the salinity of soils, soil water or downstream water quality.
- Effects on the visual quality of downstream water resources.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing irrigation sprinkler systems shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan must be prepared for use by the owner or others responsible for operating the system. The plan should provide specific instructions for operating and maintaining the system to insure that it functions properly. It should also provide for periodic inspections and prompt repair or replacement of damaged components.

The O&M plan should provide specific instructions on maximum application rates, required crop residue amounts to be maintained, recommended travel speed for continuous move systems, irrigation frequency, and other pertinent operating information.